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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/538,508	01/06/2006	Andrew Charlton Clothier	424662011500	1875

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EXAMINER	
RO, BENTSU	
ART UNIT	PAPER NUMBER
2837	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/538,508	CLOTHIER ET AL.	
	Examiner	Art Unit	
	/Bentsu Ro/	2837	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 July 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-16 and 18-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-16 and 18-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

FIRST OFFICE ACTION AFTER RCE ----- A NONFINAL REJECTION

1. Drawing correction is required as follows:

Applicant should label Figs. 1-11 and 25 as "prior art".

2. Claims should be amended as follows:

- Claim 1, line 2, change "on switched phase winding" to --one switched phase winding--; line 11, after "wherein the" insert --motor has--.
- Claims 11 and 20 should be canceled because the "impeller" has been incorporated into claim 1.

3. Claims 1-5, 7-16, 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Salama US Patent No. 6,801,441 (this is a new reference) in view of

teaching of PWM switching frequency (US Patents):

- Lacy 4,223,258;
- Warmbier et al 4,236,102;
- Park 4,329,630;
- Bitting et au 4,494,055;
- Cutler et al 4,540,920
- Reimann et al 4,567,411;

and

teaching of below 15% capacitor ripple voltage:

- Examiner's previously cited reference *Sedra/Smith; "Microelectronic Circuits", fourth edition, Oxford University press, 1998, Section 3.7, pages 179-191, the rectifier circuit;*

- *http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/rectct.html*, this website teaches a full-wave rectifier with ripple calculation for RC filter;
- *http://www.kpsec.freeuk.com/powersup.htm,* this website shows a power supply circuit with a formula for calculating a smoothing capacitor value at 10% ripple.

Claims read onto Salama's teaching as follows:

The claims:	Salama's teaching:
1. (Currently Amended) An electrical apparatus comprising:	Fig. 1 shows a 3Φ voltage-controlled PWM frequency converter; thus, the Fig. 1 circuit is an electrical apparatus;
a motor having at least on **("on" should be changed to "one")** switched phase winding having a switching frequency greater than 2 kHz	the motor is a three-phase motor having phase voltage U_R, U_S, U_T; the motor is connected to an inverter bridge 11, the inverter bridge has PWM to switch the phase voltage (or current) to each of the three phase windings; the switching frequency should be greater than 2 kHz, this is a prior art teaching, see the **"Examiner's explanation (1)"** next to this comparison chart;
and configured to drive an impeller, and	column 1, line 24 teaches the load to be a fan or a pump;
an input stage for receiving power from the alternating source,	Fig. 1 shows U_U, U_V and U_W, which are input stage for receiving power from the alternating source;
which input stage includes an input filter,	Fig. 1 shows inductor unit L_{AC};
a rectifier for rectifying the alternating signal,	Fig. 1 shows rectifier bridge 10 for rectifying the alternating signal;
a capacitor for storing energy from the rectified signal, and	Fig. 1 shows a filtering capacitor C_{DC} for storing energy from the rectified signal;
an output for outputting power from the rectifier and the capacitor to the motor,	Fig. 1 shows an inverter bridge 11 which is an output for outputting power from the rectifier and the capacitor to the motor;

where in the **motor has** at least one switched phase winding receives power from the output and wherein the capacitor is configured such that the voltage across the capacitor falls below 15% of the nominal peak rectified voltage of the source during each cycle of the alternating source.	see Fig. 1 connection of the motor 12 to the inverter 11; Salama does not show a 15% rectified voltage ripple, however, the 15% ripple is an obvious design choice, see the **"Examiner's explanation (2)".**
2 and 3.	same reasons as that of 15% ripple.
4. The power conversion apparatus of claim 1 or 2, wherein the capacitor is configured to store the amount of energy which is released from the winding when the winding is switched off.	the capacitor C_{DC} stores energy from either side of the rectifier bridge 10 or the inverter bridge 11 as long as the voltage on either side is higher than the voltage stored in the capacitor C_{DC}.
5.	switching frequency of greater than 2 kHz is prior art as explained previously in claim 1 and the following **"Examiner's explanation (1)".**
7. An electrical apparatus comprising a power conversion apparatus according to claim 1 or 2 and a pulsed load.	the motor 12 is a pulsed load.
8. An electrical apparatus according to claim 7, wherein the pulsed load is an inductive load which is repeatedly switched between an on state and an off state, wherein the duration of the on state is less than the off state	the motor 12 is an inductive load; the PWM is an operation of repeatedly switching between an on state and an off state; see column 3, line 51, the word "PWM"; the on/off state (the duty cycle) depends on the required motor torque; the duty cycle can be from 0% (no load) to

so as to minimize or avoid flux build up in the inductive load.	100% (full load); the flux build up depends on the ampere-turns of the motor winding, if winding duty cycle is low, the flux would not build up rapidly.
9 and 18.	any of the three motor windings are at least one switched phase winding.
11 and 20.	the fan blade is an impeller; see column 1, line 24.

"Examiner's explanation (1)":

Salama does not teach the PWM switching frequency being greater than 2 kHz. The switching frequency, however, is determined by two factors: (1) noise and vibration generated during switching and (2) power loss due to switching.

Noise and vibration generated during switching:

Human ears have audible frequencies between 20 Hz to 20 kHz. Outside this range, the human ears are insensitive and therefore unable to hear these frequencies. Thus, to escape the human ear hearing, the switching frequency should be outside this range.

If a motor is PWM switching at a low frequency below 20 Hz, the human ear should not be able to hear. However, this frequency range is too small for motor because 20Hz times 60 seconds gives an RPM of 1200. Most motors run at a speed higher than 1200 RPM. Thus, in order to escape the hearing of human ear, the switching frequency preferably should be 20 kHz or higher.

Power loss due to switching:

Switching causes power loss. The power loss is inevitable due to load capacitance at the switching. When a load is switched ON, the capacitance of the load (stray capacitance or other wire capacitance of the load) is charged via the switch. When the load is switch OFF, this charged electricity must dissipate and discharge to the ground. Thus, the switching causes power dissipation (or power loss) by repeatedly charging/discharging. The basic formula for power loss is

Power Loss = (constant) x C x V^2 x f

wherein C = stray capacitance of the load
V = voltage applied to the load
f = switching frequency

There is also a loss of power in the switching transistor per se. The transistor has capacitances between the electrodes. These electrode capacitances consume power during the switching similar to that of load capacitance.

From the above-shown formula, the power loss is proportional to the switching frequency. In order to minimize the power loss, the switching frequency should be as low as possible.

To optimize:

In order to minimize the power loss (switching at as low frequency as possible) and avoid hearing of vibration (not switching between 20 Hz and 20 kHz), a 20 kHz switching frequency is considered an optimal switching frequency and should be chosen for PWM. However, the optimized frequencies between 5kHz-20kHz have also been suggested. For examples:

- Lacy 4,223,258; column 4, lines 57-58 shows a switching frequency between 5-10 kHz.
- Warmbier et al 4,236,102; column 4, lines 5-8 shows a switching frequency should be above 16 kHz.
- Park 4,329,630; column 14, line 52 shows a 10kHz switching frequency;
- Bitting et au 4,494,055; column 13, line 8 shows a 20 kHz switching frequency;
- Cutler et al 4,540,920; column 5, line 26 shows a typical switching frequency of 20 kHz;
- Reimann et al 4,567,411; column 2, line 26 shows a 20 kHz switching frequency.

In view of these prior art teaching, a switching frequency of greater than 2 kHz is an obvious prior art teaching.

"Examiner's explanation (2)"

As explained previously in the examiner's manuscript, there are infinite numbers of combination can be chosen to achieve a rectifier ripple 15% or below. Even the capacitor alone has infinite numbers of values can be chosen to achieve the 15% ripple or below.

The examiner has searched through website and has found quite a few references that show the ripple calculation. The following are two of them:

- *http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/rectct.html*, this website teaches a full-wave rectifier with ripple calculation for RC filter. Page 2 of this reference shows "Ripple for RC Filter" calculation. The examiner has inputted several values of RC, and the resulting ripple values are shown.

- *http://www.kpsec.freeuk.com/powersup.htm,* this website shows a power supply circuit with a formula for calculating a smoothing capacitor value at 10% ripple (in

page 6). The formula for smoothing capacitor for 10% ripple is C = (5 x Io)/(Vs x f). As shown in this formula, there are three unknown parameters, Io, Vs, f. In an equation having three unknown parameters, the numbers of solutions to this equation are infinite.

In view of the foregoing references, to achieve the 15% or below of rectifier ripple is an obvious design choice because there is an infinite number of choices can achieve this result.

The subject matter of claims 10 and 19 (switched reluctance motor), 16 (pulsed load and switching winding), 13 and 21 (surface treating device), 14 (agitator), 12, 15, 22 (vacuum cleaner) is merely an obvious intended use. Salama's PWM frequency converter can be used with any device that requires a variable frequency power supply or a PWM power supply, including a switched reluctance motor, a surface treating device, an agitator, a vacuum clear, and many more.

4. Applicant's arguments with respect to claims 1-5, 7-16 and 18-22 have been considered but are moot in view of the new ground(s) of rejection.

Regarding the rejection of claims 2 and 3 under 35 USC 112, the examiner still believes that his interpretation is accurate and correct. However, if applicant disagrees with the examiner's interpretation, the examiner will not continue to make such a rejection. Thus, the rejection of claims 2 and 3 under USC 112 has been withdrawn.

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

6. Any inquiry concerning this communication should be directed to Bentsu Ro at telephone number 571 272-2072.

/Bentsu Ro/
Primary Examiner
Art Unit 2837